In the claims:

The listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Original) A nitride-based HEMT capable of high-frequency operation comprising:

a substrate;

a channel layer comprising InAlGaN on the substrate;

a barrier layer comprising InAlGaN on the channel layer, the barrier layer having a bandgap greater than a bandgap of the channel layer, the barrier layer and the channel layer cooperatively inducing a two-dimensional electron gas at an interface between the channel layer and the barrier layer;

at least one energy barrier adjacent one of the barrier layer and/or the channel layer, the energy barrier comprising an electron source layer in proximity with a hole source layer.

2. (Original) A HEMT according to claim 1, wherein the electron source layer comprises a layer doped with n-type dopants.

3. (Withdrawn) A HEMT according to claim 1 wherein the electron source layer comprises a heterointerface between a first InAlGaN layer and a second InAlGaN layer.

4. (Withdrawn) HEMT according to claim 1, wherein the electron source layer comprises a heterointerface between the channel layer and the barrier layer, and wherein the two-dimensional electron gas is not fully depleted by the hole source layer.

5. (Original) A HEMT according to claim 1, wherein the hole source layer comprises a layer doped with p-type dopants.

6. (Original) A HEMT according to claim 1, wherein the hole source layer comprises a layer co-doped with deep-level transition elements and shallow acceptor dopants.

7. (Original) A HEMT according to claim 1, wherein the hole source layer comprises a layer doped with deep-level acceptor dopants .

8. (Original) A HEMT according to claim 1 wherein the hole source layer comprises a heterointerface between a first InAlGaN layer and a second InAlGaN layer.

9. (Original) A HEMT according to claim 2, wherein the electron source layer is fully depleted under equilibrium conditions.

10. (Original) A HEMT according to claim 5, wherein the hole source layer is fully depleted under equilibrium conditions.

11. (Original) A HEMT according to claim 1, wherein the energy barrier provides a built-in potential barrier in excess of about 0.5V.

12. (Original) A HEMT according to claim 1, wherein the energy barrier provides a built-in potential barrier in excess of about 1V.

13. (Original) A HEMT according to claim 1, wherein the energy barrier provides a built-in potential barrier in excess of about 2V.

14. (Original) A HEMT according to claim 1, wherein the energy barrier has an associated electric field directed away from the channel.

15. (Original) A HEMT according to claim 1, wherein the energy barrier arises due to charge transfer between the electron source layer and the hole source layer.

16. (Original) A HEMT according to claim 1, wherein the energy barrier has a peak electric field in excess of about 10^5 V/cm.

17. (Original) A nitride-based HEMT capable of high-frequency operation comprising:

a substrate;

a channel layer comprising $Al_xGa_{1-x}N$ ($0 \leq x \leq 1$) on the substrate;

a barrier layer comprising $Al_yGa_{1-y}N$ ($0 < y \leq 1$) on the channel layer, the barrier layer having a bandgap greater than a bandgap of the channel layer, the barrier layer and the channel layer cooperatively inducing a two-dimensional electron gas at an interface between the channel layer and the barrier layer; and

at least one energy barrier in the barrier layer, the energy barrier comprising an electron source layer in proximity with a hole source layer and opposing the movement of electrons away from the channel layer.

18. (Original) A nitride-based HEMT capable of high-frequency operation comprising:

a substrate;

a channel layer comprising $Al_xGa_{1-x}N$ ($0 \leq x \leq 1$) on the substrate;

a barrier layer comprising $Al_yGa_{1-y}N$ ($0 < y \leq 1$) on the channel layer, the barrier layer having a bandgap greater than a bandgap of the channel layer, the barrier layer and the channel layer cooperatively inducing a two-dimensional electron gas at an interface between the channel layer and the barrier layer;

at least one energy barrier between the two-dimensional electron gas and the substrate, the energy barrier comprising an electron source layer in proximity with a hole source layer and opposing the movement of electrons away from the interface between the barrier layer and the channel layer.

19. (Original) A field effect transistor comprising:

a substrate;

a channel layer comprising InAlGaN on the substrate;

source and drain ohmic contacts in electrical communication with the channel layer;

a gate contact on the channel layer;

at least one energy barrier between the channel layer and the substrate, the energy barrier comprising an electron source layer in proximity with a hole source layer.

20. (Original) A field effect transistor comprising:

a substrate;

a buffer layer on the substrate

a channel layer comprising InAlGaN on the buffer layer;

source and drain ohmic contacts in electrical communication with the channel layer;

a gate contact on the channel layer;

an electron source layer between the channel and the buffer;

a hole source layer between the electron source layer and the buffer;

a high field region between the electron source layer and the hole source layer, the high field region providing an energy barrier opposed to the movement of electrons away from the channel layer toward the buffer.

21-30. (Cancelled)

31. (Original) A nitride-based HEMT capable of high-frequency operation comprising:

a Group III-nitride based channel layer on a substrate;

a Group III-nitride based barrier layer on the channel layer, the barrier layer having a bandgap greater than a bandgap of the channel layer, the barrier layer and the channel layer cooperatively inducing a two-dimensional electron gas at an interface between the channel layer and the barrier layer;

means for generating a built-in potential that opposes movement of carriers away from the channel layer.

32. (Original) The nitride-based HEMT of Claim 31, wherein the means for generating a built-in potential that opposes movement of carriers away from the channel layer comprises a built-in potential between the barrier layer and the channel layer and/or a built-in potential between the channel layer and the substrate.

33. (Original) The nitride-based HEMT of Claim 31, wherein the means for generating a built-in potential comprises a hole source in proximity to and spaced apart from an electron source.

34. (Original) The nitride-based HEMT of Claim 33, wherein at least one of the hole source and/or the electron source comprises a layer doped with corresponding n-type or p-type dopants.

35. (Original) The nitride-based HEMT of Claim 33, wherein the other of the at least one of the hole source and/or the electron source comprises a heterointerface structure.

36. (Original) The nitride-based HEMT of Claim 31, wherein the means for generating a built-in potential comprises a quantum well adjacent the channel layer.

37. (Original) The nitride-based HEMT of Claim 36, wherein the quantum well comprises:

a first nitride layer adjacent the channel layer, the first nitride layer having a band gap that is narrower than a band gap of the channel layer and a lattice constant that is larger than a lattice constant of the channel layer; and

a second Group III-nitride based layer adjacent the first nitride layer and opposite the channel layer, the second Group III-nitride based layer having a band gap and a lattice constant that are substantially the same as the band gap and lattice constant of the channel layer.

38. (Original) The nitride-based HEMT of Claim 37, wherein the first nitride layer comprises InN and the channel layer and second Group III-nitride based layer comprise GaN.

39. (Original) The nitride-based HEMT of Claim 37, wherein the first nitride layer has a thickness of about one or two monolayers.

40. (Original) The nitride-based HEMT of Claim 37, wherein the channel layer has a thickness of from about 30 Å to about 300 Å.